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$$\therefore x(a^2 - b^2 - 3r^2) = -2a \sec \psi (r^2 + b^2) = -2a \sec^3 \psi (a^2 + b^2).$$

$$y(a^2 - b^2 - 3r^2) = -2b \tan \psi (r^2 - a^2) = -2b \tan^3 \psi (a^2 + b^2).$$

By division, $\sin \psi = (y/b)^{\frac{1}{3}} / (x/a)^{\frac{1}{3}}$.

Eliminating ψ between the last two equations,

$$[(x/a)^{\frac{2}{3}} - (y/b)^{\frac{2}{3}}](a^2 - b^2 - 3r^2)^{\frac{2}{3}} = [2(a^2 + b^2)]^{\frac{2}{3}}.$$

$$\therefore [(x/a)^{\frac{2}{3}} - (y/b)^{\frac{2}{3}}]^{\frac{3}{2}}(a^2 - b^2 - 3r^2) = 2(a^2 + b^2).$$

$$\text{Now } r^2 = a^2 \sec^2 \psi + b^2 \tan^2 \psi = \frac{a^2(x/a)^{\frac{2}{3}} + b^2(y/b)^{\frac{2}{3}}}{(x/a)^{\frac{2}{3}} - (y/b)^{\frac{2}{3}}}.$$

$$\begin{aligned} \therefore [(x/a)^{\frac{2}{3}} - (y/b)^{\frac{2}{3}}]^{\frac{3}{2}} \{ (a^2 - b^2)[(x/a)^{\frac{2}{3}} - (y/b)^{\frac{2}{3}}] - 3[a^2(x/a)^{\frac{2}{3}} + b^2(y/b)^{\frac{2}{3}}] \}, \\ \qquad \qquad \qquad = 2(a^2 + b^2). \\ \text{or } [(x/a)^{\frac{2}{3}} - (y/b)^{\frac{2}{3}}]^{\frac{3}{2}} [(y/b)^{\frac{2}{3}} (\frac{1}{2}a^2 - b^2) - (x/a)^{\frac{2}{3}} (a^2 + \frac{1}{2}b^2)] = a^2 + b^2, \text{ the caustic} \\ \text{required.} \end{aligned}$$

PROBLEMS FOR SOLUTION.

ARITHMETIC.

104. Proposed by ALOIS F. KOVARIK, Instructor in Mathematics and Physics, Decorah Institute, Decorah, Iowa.

If I should buy goods at a price 20% higher than I did buy them, and sell the goods for the same amount that I did sell them, I would gain 25% less than I did gain. What per cent. did I gain? (Solve by Arithmetic).

105. Proposed by ALOIS F. KOVARIK, Instructor in Mathematics and Physics, Decorah Institute, Decorah, Iowa.

A teacher looks at his watch when leaving school at noon. When he comes back he finds that the hour hand and the minute hand had just changed places (that they had when he left the school). What time was it when he left, and what time when he came back to school? (Solve by Arithmetic).

*** Solutions of these problems should be sent to B. F. Finkel not later than February 10.

GEOMETRY.

111. Proposed by GEORGE R. DEAN, Professor of Mathematics, University of Missouri School of Mines and Metallurgy, Rolla, Mo.

Given that the area of a triangle is equal to half the product of two sides and the sine of the included angle, prove that $\sin(x+y) = \sin x \cos y + \cos x \sin y$.

112. Proposed by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy, Ohio State University, Athens, Ohio.

The tangent planes at A, B, C, D to the sphere circumscribing the tetrahedron $ABCD$ form a tetrahedron $abcd$; prove that Aa, Bb, Cc, Dd will meet in a point if $BC \cdot AD = CA \cdot BD = AB \cdot CD$.

113. Proposed by T. W. PALMER, Professor of Mathematics, University of Alabama, University, Alabama.

Given three concentric circles. Draw a straight line from the inner to the outer circumference that shall be bisected by the middle circumference.

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MECHANICS.

79. Proposed by WALTER H. DRANE, Graduate Student, Harvard University, Cambridge, Mass.

The four wheels of a street car are rigidly fixed to their axles so that axles and wheels turn together. Is it more advantageous to apply the brakes to the front or to the rear wheels, supposing the brakes to block the wheels in each case ?

80. Proposed by B. F. FINKEL, A. M., M.Sc., Professor of Mathematics and Physics, Drury College, Springfield, Mo.

A circular board is placed on a smooth horizontal plane and a boy runs with uniform speed around on the board close to its edge. Find the motion of the center of the board.

81. Proposed by JAMES S. STEVENS, Professor of Physics, The University of Maine, Orono, Me.

Two iron spheres whose weights are a and b and a is greater than b , are suspended over a frictionless pulley so that they move in a liquid medium of density δ . Assume that the density of the iron is δ' , what would be the spaces passed over (downward by a and upward by b) in the first four seconds, if the spheres start from rest ?

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EDITORIALS.

We take this opportunity to express our thanks to our valued contributor, Prof. J. Scheffer, for preparing the index to this volume of the MONTHLY.

Prof. Edgar W. Bass, author of *Elements of Differential Calculus*, and Professor of Mathematics in the United States Military Academy at West Point for the past twenty years, has been placed on the retired list.

This issue concludes the fifth volume of the MONTHLY. The benefit the MONTHLY has done for the progress and advancement of mathematics during the past year must be told by others, but from the many enthusiastic testimonials we have received during the course of the year, the inference is that it is quite material. A number of important articles by some of our foremost mathematicians have appeared during the year. These articles are of the highest interest and value, dealing as they do with the more recent discoveries in mathematics. It is to be hoped that a larger number of contributors in the new fields of mathematical investigation will be added to those who are now carrying on this work ; for we believe that no other mathematical journal in this country offers such a great opportunity to reach the large body of teachers of mathematics as does the MONTHLY.